

FIS920030135US1  
(126-0027)

### REMARKS

Claims 1-23 were pending in the present amendment.

Reconsideration and allowance of the claims is respectfully requested in view of the amendments and the following remarks.

#### Claim Rejection Under 35 U.S.C. §102(b)

Claims 1 and 8-14 stands rejected under 35 USC §102(b) as being anticipated by US Patent No. 5,930,655 to Cooney, III et al. (hereinafter "Cooney"). Applicant respectfully traverses.

Cooney is generally directed to a process for improving degradation resistance of conductor layers utilized in fabrication of an integrated circuit employing fluorine barrier layers. In its process, Cooney discloses a denuding process that depletes surfaces regions of insulator material of all of its fluorine content. In fact, its claims refer to fluorine-free barrier layers. The denuding process is described in two different embodiments. The first embodiment is directed to a thermally activated denuding process. The thermally activated denuding process includes exposing the substrate to an environment at 400°C with H<sub>2</sub> or Ar/H<sub>2</sub> gas in a furnace tube at atmospheric pressure for a period of time effective to denude fluorine from the substrate. As such, the thermally activated denuding process does not include exposing the substrate to atomic hydrogen species. The second embodiment is directed to exposing the substrate to an oxidizing plasma formed from O<sub>2</sub> or O<sub>2</sub>/O<sub>3</sub>. Again, there is no disclosure of exposing the substrate to atomic hydrogen species to remove fluorine from the substrate.

Claim 1 is directed to a process for lowering fluorine content after metal fill and planarization of a metal conductor and fluorine-containing dielectric wire structure. The process comprises generating atomic hydrogen species; and exposing the fluorine-containing dielectric to the atomic hydrogen species in an amount effective to lower the fluorine content in the fluorine-containing dielectric.

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To anticipate a claim under 35 U.S.C. § 102, a single source must contain all of the elements of the claim. *Lewmar Marine Inc. v. Barient, Inc.*, 827 F.2d 744, 747, 3 U.S.P.Q.2d 1766, 1768 (Fed. Cir. 1987), *cert. denied*, 484 U.S. 1007 (1988).

Cooney fails to anticipate Claim 1 because Cooney fails to disclose exposing the fluorine-containing dielectric to atomic hydrogen species. As noted above, Cooney generally discloses two embodiments for denuding fluorine from the substrate. The first embodiment is directed to a thermally activated denuding process, the particular disclosure of which is reproduced below:

For thermally activated conditions used to denude fluorine, the surface regions of the fluorine containing layer can be exposed to an environment at 400°C. and H<sub>2</sub> or Ar/H<sub>2</sub> gas flowed through a furnace tube at atmospheric pressure, for 1 to 60 minutes, preferably about 30 minutes, to denude fluorine.

(Cooney, Col. 6, ll. 38-44)

Since the process is characterized as a thermal process, which is evidenced by Cooney's use of a furnace tube and the elevated temperature, the thermally activated process does not expose the surface to atomic hydrogen species.

The second embodiment is directed to a plasma enhanced gas reaction to effect fluorine removal from the substrate, the particular disclosure of which is reproduced below:

For plasma enhanced gas process conditions used to denude fluorine, the surface regions of the fluorine containing layer can be exposed to a reaction chamber environment of O<sub>2</sub> or O<sub>2</sub>/O<sub>3</sub> plasma in a pressure range of 3 millitorrs to 100 Torr at 400°C. for 10 to 300 seconds, preferably about 60 seconds. More specifically, one exemplary set of conditions for denuding fluorine from the surface regions of the fluorine containing layer uses a feed gas mixture of 400 sccm O<sub>3</sub>/3600 sccm O<sub>2</sub>, a reaction chamber temperature of 400°C. and pressure of 30 Torr, and 600 watts rf and 0.7 cm reactor spacing in an Applied Materials P500 Universal CVD chamber.

(Cooney, Col. 6, ll. 44-55)

Since Cooney clearly discloses the use of O<sub>2</sub> or O<sub>2</sub>/O<sub>3</sub> plasma, the plasma enhanced gas reaction does not expose the surface to atomic hydrogen species.

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Accordingly, Cooney does not disclose each and every claimed element and the rejection applied to Claim 1 should be withdrawn. Since Claims 8-14 variably depend from Claim 1 and include the feature of exposing the fluorine-containing dielectric to the atomic hydrogen species, these claims are not anticipated by Cooney for at least the same reasons.

Claim Rejection under 35 USC §102(e)

Claims 15-16 and 21-23 stand rejected as being anticipated by US Patent No. 6,433,432 to Shimzu. Applicant respectfully traverses.

Shimzu is generally directed to a process for integrating a fluorinated insulating layer into the manufacture of an integrated circuit. The process includes, inter alia, exposing a copper film to an ammonia (NH<sub>3</sub>) plasma.

Independent Claim 15 is directed to a process for forming a wiring structure including a copper metal conductor and a fluorine-containing dielectric. The process comprises, inter alia, forming a plasma from a hydrogen bearing gas to generate atomic hydrogen species, wherein the hydrogen bearing gas comprises a hydrocarbon, a hydrofluorocarbon, a hydrogen gas, a water vapor, or mixtures comprising at least one of the foregoing hydrogen bearing compounds.

Independent Claim 23 is directed to a process for lowering fluorine content after metal fill and planarization of a metal conductor and fluorine-containing dielectric wire structure comprising, inter alia, generating atomic nitrogen species from nitrogen gas or a mixture containing the nitrogen gas.

As discussed above, to anticipate a claim under 35 U.S.C. § 102, a single source must contain all of the elements of the claim.

Shimzu fails to disclose forming a plasma from a hydrogen bearing gas to generate atomic hydrogen species, wherein the hydrogen bearing gas comprises a hydrocarbon, a hydrofluorocarbon, a hydrogen gas, a water vapor, or mixtures comprising at least one of the foregoing hydrogen bearing compounds as recited in Claim 15. Likewise, Shimzu fails to disclose generating atomic nitrogen species from nitrogen gas or a mixture containing the

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nitrogen gas. Rather, Shimzu discloses forming a plasma from ammonia only. No other gases are disclosed.

In view of the foregoing, Shimzu fails to anticipate Claims 15 and 23. Given that Claims 16 and 21-22 depend from Claim 15, these claims are not anticipated by Shimzu for at least the same reasons. Accordingly, the rejection is requested to be withdrawn.

Claim Rejection Under 35 U.S.C. §103(a)

Claims 2-7 stand rejected under 35 U.S.C. §103(a), as allegedly unpatentable over Cooney. Applicants respectfully traverse.

Cooney is discussed above.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success resulting from the combination. Finally, the prior art references must teach or suggest all claim limitations.

A prima facie case has not been established in the present Office Action because Cooney fails to teach or suggest, among other features, generating atomic hydrogen species. As previously discussed, Cooney generally teaches and suggests two methods for denuding fluorine. The first method generally teaches and suggests a thermally activated denuding process, which employs a furnace tube and elevated temperatures (e.g., 400°C) to remove fluorine. The thermally activated process does not generate atomic hydrogen species. The second method generally describes a plasma enhanced denuding process. The method teaches and suggests the use of an oxidizing plasma formed from O<sub>2</sub> or O<sub>2</sub>/O<sub>3</sub>. Again, this method fails to teach or suggest generating atomic hydrogen species. As such, Cooney fails to establish a prima facie case against Claims 2-7, which include this feature.

Accordingly, the rejection is requested to be withdrawn.


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It is believed that the foregoing remarks fully comply with the Office Action and place the application in condition for immediate allowance; which action is earnestly solicited.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 09-0458 maintained by Applicants' Attorneys.

Respectfully submitted,

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